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IS : 3608 (Part 1) - 1987

Indian Standard

SPECIFICATION FOR
GLASS ALCOHOLOMETERS

PART 1 GLASS ALCOHOLOMETERS WITHOUT THERMOMETER

(First Revision)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR GLASS ALCOHOLOMETERS

PART 1 GLASS ALCOHOLOMETERS WITHOUT THERMOMETER (First Revision)

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Indian Standard

SPECIFICATION FOR GLASS ALCOHOLOMETERS

PART 1 GLASS ALCOHOLOMETERS WITHOUT THERMOMETER

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 1) (First Revision) was adopted by the Indian Standards Institution on 1 January 1987, after the draft finalized by the Laboratoryware and Related Apparatus Sectional Committee had been approved by the Chemical Division Council.

0.2 This standard was originally published as IS : 3608-1966* covering alcoholometers without thermometer. Subsequently, International Organization for Standardization (ISO) brought out the following standards:

ISO 4801-1979 Glass alcoholometers and alcohol hydrometers not incorporating a thermometer

ISO 4805-1982 Laboratory glassware — Thermo-alcoholometers and alcohol-thermo-hydrometers

The Committee responsible for the preparation of this standard decided to revise IS : 3608-1966* to align this standard with the above ISO Standards. Accordingly, this standard has now been revised in two parts: Part 1 Glass alcoholometers without thermometer; and Part 2 Glass alcoholometers with thermometer.

0.3 In this revision, the alcoholometers having 0.2° graduation (type B) have been omitted as the same are not in use. Instead two classes of accuracy have been introduced for glass alcoholometers without thermometer; class A for more accurate work and class B for normal work. Alcoholometer with thermometer has also been included. However, in the case of alcoholometer with thermometer only one type of accuracy, namely class B, has been prescribed. Modifications in dimensions of alcoholometers have been made. Reference temperature has been changed from 15 to 20°C in order to align with the international practice.

*Specification for glass alcoholometers.

0.4 This standard contains clause 9.2 which calls for agreement between the purchaser and the supplier.

0.5 Besides the specifications for alcoholometers the following two Indian Standards on alcoholometric tables have also been published:

IS : 2302-1962 Tables for alcoholometry (by centesimal hydrometers)

IS : 3506-1967 Tables for alcoholometry (by pycnometer method)

These tables are presently based on reference temperature of 15°C. However, to fall in line with the international practice to achieve the utmost accuracy, these tables are being revised to 20°C reference temperature.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the requirements and the methods of sampling and test for alcoholometers meant for determining the ethanol content in ethanol-water mixtures at 20°C.

1.1.1 The basis of graduations of these alcoholometers are the values of density versus composition of ethanol solutions by volume as given in Table 1 of this standard and are based on values adopted by the International Organization of Legal Metrology (OIML).

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 1382-1981†, in addition to the following, shall apply.

2.1 Alcoholometer — An instrument which indicates the alcoholic strength by volume of a mixture of water and ethanol.

2.2 Bulb — The wider portion of the alcoholometer containing the loading material.

2.3 Ethanol Content (at Temperature $t^{\circ}\text{C}$) — The number of parts by volume of ethanol at 20°C contained in 100 parts by volume of the liquid at temperature $t^{\circ}\text{C}$.

*Rules for rounding off numerical values (revised).

†Glossary of terms relating to glass and glassware (first revision).

2.4 Stem — The thin tubing attached to the upper part of the bulb containing the indicating scale.

2.5 Observed Degree — The percentage volume of ethanol of an alcoholic solution at temperature other than 20°C. The observed degree shall always be given with the temperature of the liquid.

2.6 Observed Volume — The volume of the liquid at the temperature at which it actually is. The observed volume shall be expressed in litres at the particular temperature, for example, 1.025 3 litres at 25°C.

3. CLASSIFICATION

3.1 The alcoholometers shall have two classes of accuracy:

- a) *Class A* — For higher accuracy, having accuracy of $\pm 0.05^\circ$.
- b) *Class B* — For normal work, having accuracy of $\pm 0.1^\circ$.

4. TEMPERATURE OF CALIBRATION AND RANGE OF SCALES

4.1 Temperature of Calibration — The alcoholometers shall be calibrated at 20°C.

4.2 Range of Scale — The alcoholometers shall cover the entire range of 0 to 100° in steps of 10 degrees on each alcoholometer. An additional alcoholometer may be provided to cover the range 93 to 103°.

NOTE — Alcoholic contents more than 100 percent volume are imaginary (see Table 1). These values are necessary for adjustment of alcoholometers in highly concentrated alcohol-water mixtures at temperature between 20 to 40°C, the density of which formally corresponds to alcohol content more than 100 percent.

5. BASIS OF SCALE

5.1 The basis of scale of each type of alcoholometer shall be the values of density versus composition of ethanol solutions by volume as given in Table 1.

6. SURFACE TENSION

6.1 In marking graduation lines the conventional values given in Table 1 shall be assumed for the surface tension at 20°C of ethanol solutions of various concentrations.

7. REFERENCE LEVEL FOR READING

7.1 The alcoholometers shall be graduated for reading at the level of the free horizontal surface of the liquid.

TABLE 1 ETHANOL CONTENT BY VOLUME, DENSITY AND SURFACE TENSION AT 20°C

[Clauses 1.1.1, 4.2 (Note), 5.1 and 6.1]

OBSERVED DEGREE PER- CENT VOLUME	DENSITY kg/m ³	SURFACE TENSION mN/m	OBSERVED DEGREE PER- CENT VOLUME	DENSITY kg/m ³	SURFACE TENSION mN/m	OBSERVED DEGREE PER- CENT VOLUME	DENSITY kg/m ³	SURFACE TENSION mN/m
(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
0	998.20	72.6	35	955.59	33.3	70	885.56	26.7
1	996.70	68.1	36	954.15	32.9	71	883.06	26.6
2	995.23	64.5	37	952.69	32.6	72	880.54	26.5
3	993.81	61.7	38	951.18	32.3	73	877.99	26.4
4	992.41	59.6	39	949.63	31.9	74	875.40	26.3
5	991.06	57.8	40	948.05	31.7	75	872.79	26.2
6	989.73	56.1	41	946.42	31.4	76	870.15	26.1
7	988.43	54.5	42	944.76	31.1	77	867.48	25.9
8	987.16	53.1	43	943.06	30.9	78	864.78	25.8
9	985.92	51.8	44	941.32	30.6	79	862.04	25.7
10	984.71	50.5	45	939.54	30.4	80	859.27	25.6
11	983.52	49.4	46	937.73	30.2	81	856.46	25.4
12	982.35	48.3	47	935.88	30.0	82	853.62	25.3
13	981.21	47.2	48	934.00	29.8	83	850.74	25.2
14	980.08	46.3	49	932.09	29.6	84	847.82	25.0
15	978.97	45.4	50	930.14	29.4	85	844.85	24.9
16	977.87	44.5	51	928.16	29.3	86	841.84	24.8
17	976.79	43.7	52	926.16	29.1	87	838.77	24.6
18	975.71	42.9	53	924.12	28.9	88	835.64	24.5
19	974.63	42.1	54	922.06	28.8	89	832.45	24.4
20	973.56	41.4	55	919.96	28.6	90	829.18	24.2
21	972.48	40.7	56	917.84	28.5	91	825.83	24.1
22	971.40	40.0	57	915.70	28.3	92	822.39	23.9
23	970.31	39.3	58	913.53	28.2	93	818.85	23.8
24	969.21	38.7	59	911.33	28.1	94	815.18	23.6
25	968.10	38.1	60	909.11	27.9	95	811.38	23.4
26	966.97	37.5	61	906.87	27.8	96	807.42	23.3
27	965.81	37.0	62	904.60	27.7	97	803.27	23.1
28	964.64	36.4	63	902.31	27.6	98	798.90	22.9
29	963.44	35.9	64	899.99	27.4	99	794.25	22.6
30	962.21	35.4	65	897.65	27.3	100	789.24	22.4
31	960.95	35.0	66	895.28	27.2	101	783.75	22.2
32	959.66	34.5	67	892.89	27.1	102	778.26	22.0
33	958.34	34.1	68	890.48	27.0	103	772.77	21.8
34	956.98	33.7	69	888.03	26.9			

8. REQUIREMENTS

8.0 Alcoholometers shall conform with the general requirements given in IS : 9621-1980*.

8.1 Materials

8.1.1 Glass — The alcoholometers shall be made of colourless transparent glass, resistant to chemicals and thermal shock encountered in use. It shall be as free as possible from strain and visual defects.

8.1.1.1 The coefficient of cubical thermal expansion of glass shall be $(25 \pm 2) \times 10^{-6}$ per degree celsius.

8.1.2 Loading Material — The loading material shall be confined to the bottom of the bulb. After the instrument has been maintained in a horizontal position for 1 hour at 80°C and subsequently cooled in that position it shall meet the requirements of **8.2**.

NOTE — The use of mercury as loading material is *not permitted*.

8.1.2.1 There shall be no loss material whatsoever in any part of the instrument.

8.2 Pattern, Workmanship and Finish — The alcoholometer shall be of a pattern as shown in Fig. 1.

8.2.1 It shall be circular in cross-section, robust and symmetrical about the main axis. It shall float vertically in alcoholic solutions of appropriate strength and the inclination, if any, from the vertical, shall not exceed 1.5 degrees.

8.3 Scale — The alcoholometer shall have only one scale. The scale and inscriptions shall be marked on a smooth matt surface of white or off-white colour. It shall be straight and free from twist. Neither the scale nor the graduations shall distort or discolour when the alcoholometer is maintained at a temperature of 80°C for 24 hours. The alcoholometer scale shall be fully enclosed in the alcoholometer with all graduation marks clearly visible on the stem.

8.3.1 A reference mark consisting of a short horizontal straight line with a 'V' at each end, thus >--< shall be marked in the paper scale a few millimetres above the topmost graduation mark. A fine, clearly etched permanent line of uniform thickness shall be etched on the stem of the alcoholometer coincident with the horizontal portion of the reference mark and slightly longer than that portion of the reference mark, so that the ends of the etched lines project into the 'Vs' at the ends of the reference mark.

*Principles of constructions and adjustment of glass hydrometers.

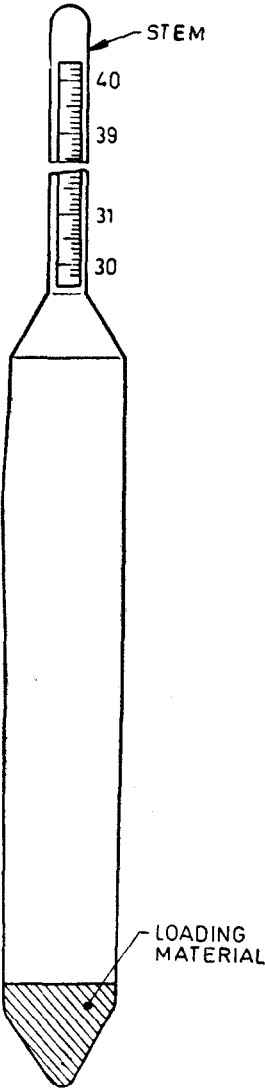


FIG. 1 GLASS ALCOHOLOMETER WITHOUT THERMOMETER

8.3.2 The graduation lines shall be distinct and of uniform thickness not exceeding one fifth of the distance between the centres of adjacent graduation lines or 0.2 mm, whichever is less. There shall be no evident local irregularities in their spacing. They shall be perpendicular to the axis of the alcoholometer.

8.3.3 The nominal range of each alcoholometer shall not exceed 10 degrees. Each alcoholometer shall carry five to ten additional graduation lines beyond the nominal limits at both ends of the scale.

8.3.4 The long, medium and short graduation lines shall extend respectively to at least one-half, one-third and one-fifth of the circumference of the stem.

8.3.5 Sequence of Graduation Lines — Every tenth graduation line shall be a long line. There shall be a medium line between two consecutive long lines and four short lines between consecutive medium and long lines.

8.3.6 Figuring of Graduation Lines — The highest and the lowest graduation lines referring to the nominal range of the alcoholometer shall be figured in full. At least every long graduation line shall be figured. Graduation lines within the nominal range and the inscription shall be marked in black. Graduation lines outside the nominal range may be marked in colour other than black.

8.4 Dimensions — The dimensions shall be as given in Table 2.

8.4.1 The cross section of the stem shall remain unchanged for at least 5 mm below the lowest graduation line.

8.4.2 The stem shall extend at least 15 mm above the uppermost graduation line on the scale.

8.5 Accuracy — The error at any point on the scale shall not exceed $\pm \frac{1}{2}$ small division for Class A alcoholometers, and ± 1 small division for Class B alcoholometer.

8.5.1 The accuracy of the alcoholometers shall be tested in accordance with the procedure prescribed in Appendix A.

9. MARKING AND PACKING

9.1 Marking — Each alcoholometer shall be marked legibly and indelibly with the following information:

- Maker's name or recognized trade-mark, if any;
- The word 'Alcoholometer';
- The accuracy class, for example 'Class B';
- Calibration temperature, that is, 20°C; and
- Identification mark, if any.

TABLE 2 REQUIREMENTS FOR GLASS ALCOHOLMETERS

(Clause 8.4)

CLASS	RANGE, DEGREES	OVERALL LENGTH <i>Max</i>	SCALE LENGTH <i>Min</i>	SCALE SUB- DIVISION, DEGREE	STEM, DIA- METER <i>Min</i>	BULB DIA- METER		VOLUME BELOW SCALE		TOLERANCE AT ANY POINT, DEGREE
						<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	
	mm	mm	mm		mm	mm	mm	cm ³	cm ³	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
A	0-10 10-20 20-30 30-40 40-50 50-60	400	150	0.1	3.5	36	38	160	180	± 0.05
B	60-70 70-80	340	105	0.1	3.5	32	36	130	150	± 0.05
A	80-90 90-100	400	150	0.1	3.5	26	28	65	85	± 0.05
B	0-10 10-20 20-30 30-40 40-50 50-60	340	105	0.1	3	32	36	120	140	± 0.1
A	60-70 70-80	340	105	0.1	4	28	30	90	110	± 0.1
B	80-90 90-100	340	105	0.1	4	23	27	50	65	± 0.1

9.1.1 The alcoholometers may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

9.2 Packing — The alcoholometers shall be securely packed as agreed to between the purchaser and the supplier.

10. SAMPLING

10.1 The method of drawing representative samples of the alcoholometers and the criteria for conformity shall be prescribed in Appendix B.

A P P E N D I X A

(Clause 8.5.1)

METHOD OF TESTING ACCURACY OF ALCOHOLOMETERS

A-1. GENERAL

A-1.1 Checking of alcoholometer shall be done by one of the following methods:

- a) Comparison with a similar Standard Alcoholometer (**A-2**); and
- b) Verifying the readings of alcoholometer at 20°C by determining the density of the liquid at the same temperature by pycnometer and then finding the observed degree corresponding to particular density from Table 1.

A-2. COMPARISON METHOD

A-2.1 Readings of the liquid shall be taken simultaneously with the alcoholometer under test and that by a similar but Standard Alcoholometer under similar conditions. The readings shall be taken at four or five different points covering the entire range.

A-2.2 The readings by alcoholometers shall be taken in a circular or preferably a rectangular vessel suitable for the alcoholometer. Dimensions of appropriate vessels are given in Table 3.

TABLE 3 RECOMMENDED SIZES OF VESSELS

(Clause A-2.2)

INTERNAL SIZE OF VESSEL	
Rectangular (mm)	Circular (mm)
$(135 \pm 5) \times (55 \pm 3) \times (430 \pm 5)$	$(125 \pm 5) \times (430 \pm 5)$

A-3. VERIFICATION BY PYKNOMETER

A-3.1 A suitable pycnometer of 25 ml capacity, such as shown in Fig. 2 or pycnometer type 3 of IS : 5717-1970* shall be used. The determination shall be carried out at 20°C.

A-3.2 Pour the liquid under test in a weighed pycnometer taking due care that no air is entrapped. Allow the level of the liquid to rise slightly above the mark on the neck of the pycnometer. Place the pycnometer in a bath so that it is immersed in the bath up to a height slightly below the mark. Maintain the bath at 20°C for about half an hour so that the liquid and the pycnometer acquire the temperature of the bath. Adjust the liquid level such that the meniscus just touches the mark on the neck of the pycnometer. Remove the pycnometer from the bath, wipe, dry and weigh; and determine the mass of the liquid.

A-3.3 The true mass of the liquid is calculated by adding to the observed mass of the liquid a correction for the buoyancy effect of the air. This correction is calculated from the following formula:

$$C = P (V - m/d)$$

where

C = correction factor,

P = density of air at the temperature of experiment,

V = volume in ml of liquid in the pycnometer at 20°C,

m = observed mass in g of the liquid, and

d = density of the material of weights at the temperature of experiment.

A-3.4 Calculate the density of the liquid at 20°C by dividing the mass of the liquid as obtained above by volume at 20°C and subsequently find out corresponding degree from Table 1. Any departure from this value in the reading of alcoholometer for the same solution at 20°C separately shall be taken as error at the corresponding point on the scale.

*Specification for pycnometers.

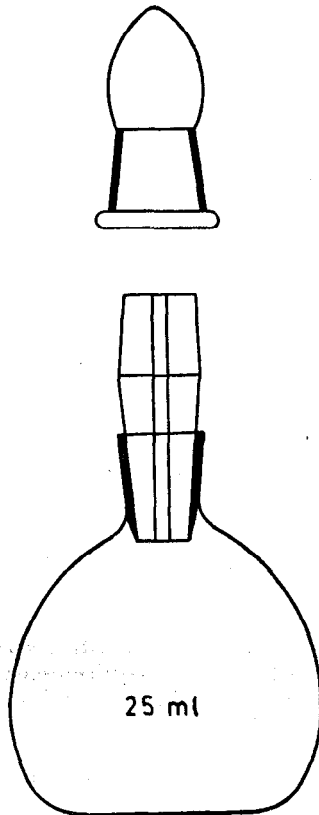


FIG. 2 PYKNOMETER

APPENDIX B

(Clause 10.1)

SAMPLING SCHEME FOR GLASS ALCOHOLOMETERS WITHOUT THERMOMETER

B-1. SCALE OF SAMPLING

B-1.1 Lot — All the alcoholometers of one type and range shall constitute one lot.

B-1.2 Samples shall be taken from each lot for ascertaining the conformity to this specification and shall be according to Table 4.

TABLE 4 NUMBER OF ALCOHOLOMETERS TO BE SELECTED

LOT SIZE	SAMPLE SIZE	ACCEPTANCE NUMBER
(1)	(2)	(3)
Up to 15	2	0
16 to 25	3	0
26 to 50	5	0
51 to 100	8	1
101 and above	13	2

B-1.2.1 The sample shall be selected from the lot at random and in order to ensure the randomness of selection, the method given in IS : 4905-1968* may be followed.

B-2. CRITERIA FOR CONFORMITY

B-2.1 The samples selected according to col 2 of Table 4 shall be tested for the requirements given in **8.2, 8.3** and **8.5**. The lot shall be declared as conforming to these requirements if all the alcoholometers of the sample satisfy these requirements.

B-2.2 When the lot has been accepted with respect to the requirements of **8.2, 8.3** and **8.5** the test for other requirements given in **8** shall be done on the samples selected. If an alcoholometer fails to satisfy any of the requirements given in **8**, it shall be declared as defective. The lot shall be declared as conforming to the requirements of **8** if the number of defectives in the lot does not exceed the corresponding acceptance numbers given in col 3 of Table 4.

*Methods for random sampling.

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